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Abstract:
PROBLEM TO BE SOLVED: To eliminate complicated wiring from an internal link of an ATM switch, to flexibly cope with the increase and decrease of input-output lines and also to reduce lost-call rate when traffic bias occurs. SOLUTION: An optical device that is called a barrel shifter 6 is used and an internal link is simplified. The shifter 6 has a function that allocates an optical signal of the wavelength λ_p of the n-th input to the (n+p)-th output, and wavelength multiple links 5-11 to 5-18 and 5-21 to 5-28 perform connections between plural input switch blocks IN1 to IN8 and the shifter 6 and between plural output switch blocks OUT1 to OUT8 and the shifter 6. Traffic bias is coped with by providing a bypass route, i.e., by routing a cell that is outputted from the blocks OUT1 to OUT8 to the blocks IN1 to IN8 again.
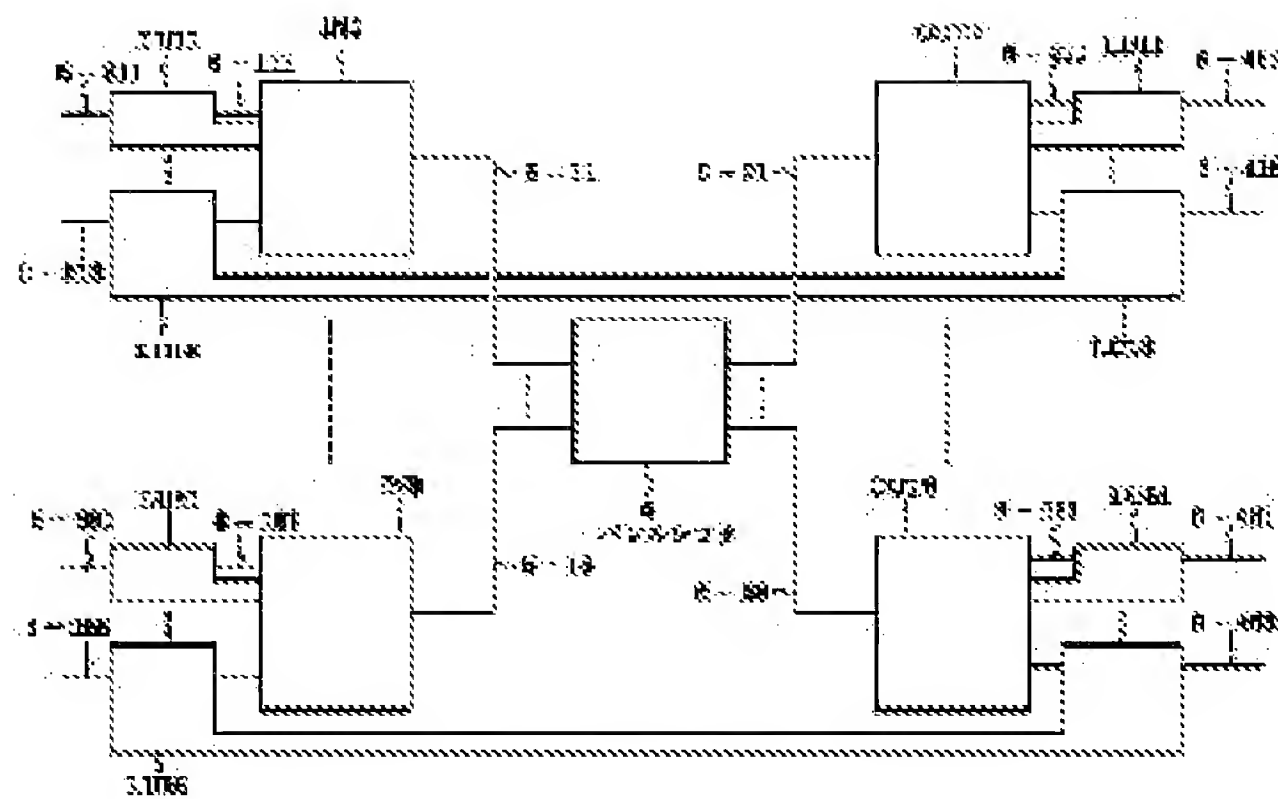
JPO Machine translation abstract:
(57) **Abstract**
SUBJECT Complicated wiring is lost from the internal link of an ATM switch, and it corresponds flexibly to the change in an input-and-output circuit. A lost-call rate when the bias of traffic occurs is reduced.
Means for Solution An internal link is simplified using optical devices called barrel shifter. Barrel shifter has the function to distribute a lightwave signal of wavelength $lambda_p$ of the n-th input to an output of eye watch (n+p), and connection by a wavelength multiplexing link is made between two or more input switch blocks and output switch blocks, and this barrel shifter. About a bias of traffic, it is coped with by providing a bypass route by carrying out routing of the cell outputted from output switch blocks to an input switch block again.

Claim(s)
Claim 1 A basic switch which distributes a cell which accommodates two or more line input and comes from this line input to N tracks, respectively.
An electric phototransducer which changes into a lightwave signal of wavelength ($lambda_0$ - $lambda_{N-1}$) of N pieces different, respectively N cells outputted from this basic switch.
A branching filter which separates spectrally an input switch block provided with a multiplexing machine which multiplexs a lightwave signal of this wavelength of N pieces to one wavelength-multiplexing-light signal into a lightwave signal of wavelength ($lambda_0$ - $lambda_{N-1}$) of N pieces which is different, respectively in two or more preparations and said one wavelength-multiplexing-light signal.
A photoelectricity converter which changes a lightwave signal of this wavelength ($lambda_0$ - $lambda_{N-1}$) of N pieces into N cells, respectively.
A basic switch which distributes this N cell to two or more output lines, respectively.
Are the above the ATM switch which it had and An output link of two or more of said multiplexing machines, It has barrel shifter which distributes a lightwave signal of wavelength $lambda_p$ (0 <=p<=N-1) of the n-th input (0 <=n<=N-1) to an output of eye watch (mod N (n+p)) between input links of two or more of said branching filters, It had a means to input into

said input switch block by return a cell outputted from said output switch blocks.

Claim 2 The ATM switch according to claim 1 containing a means to change a header of a cell to which said means which carries out a clinch input was outputted from said output switch blocks for re-routing.

Claim 3 The ATM switch according to claim 1 provided with a means to copy and distribute a cell inputted into said input switch block to desired two or more addresses.

Claim 4 The ATM switch according to claim 1 or 3 provided with a means to copy and distribute a cell outputted from said output switch blocks to desired two or more addresses.

Detailed Description of the Invention
0001
Field of the Invention This invention is used for ATM (Asynchronous Transfer Mode: Asynchronous Transfer Mode) communication. This invention relates to the art which carries out wire saving of the internal link of an ATM switch. This invention relates to the art of applying optical devices since an ATM switch is constituted.
0002
Description of the Prior ArtA conventional example is explained with reference to drawing 7 and drawing 8. Drawing 7 is a figure showing the composition of the 4x4 basic switch in the conventional ATM switch. Drawing 7 explains an input buffer type basic switch among the composition of a basic switch (reference: a point illustration type standard ATM textbook, the ASCII publication office (ISBN4-7561-0250-6)).
0003 Operation of the conventional basic switch is explained with reference to drawing 7. In drawing 7, the numerals 1 are crosspoints which transmit an ATM cell to a desired output. The numerals 2-1 to 2-4 are input buffers which accumulate the cell which came temporarily. The numerals 2 are controllers which perform contention control of a cell. The numerals 3-1 to 3-4 are output highways.
0004 It communicates between each input buffer 2-1 to 2-4, and it obtains permission of sending out by the controller 2 so that it may not transmit to the same output highway 3-1 to 3-4 from the input buffer 2-1 to 2-4. The crosspoint 1 is provided with address filter AF, and transmits a cell to the applicable output highway 3-1 to 3-4 based on the information in a header.
0005 Drawing 8 is a figure showing the composition of the conventional ATM switch. Using the basic switch of 4x4 shown by drawing 7 two or more, as shown in drawing 8, an ATM switch is constituted. In drawing 8, it is a link with which the numerals 4-11-24 connect a basic switch, and the numerals 5-11-13 connect between basic switches. Thus, the ATM switch of 16x16 can be constituted using the basic switch of 4x4.
0006
Problem(s) to be Solved by the Invention In constituting an ATM switch as shown in drawing 8, using the basic switch shown in drawing 7 two or more, 16 4x4 is needed, and the wiring itself becomes entangled mutually, and a link becomes complicated.
0007 Since the number of basic switches will be tens of pieces or hundreds of pieces, a large-scale actual ATM switch will become huge **the number of links** .
0008 Although constituted using an optical fiber, a link requires time and effort for the process of connecting wiring, and since the check process for avoiding faulty wiring etc. is further added to this, it causes the rise of apparatus cost, and long time-ization of a construction period. Whenever it fluctuates a basic switch, it is necessary to change wiring again to all the basic switches, and the flexibility of the change in a basic switch is low.
0009 Although drawing 9 is a figure showing the congestion state of traffic, as shown in drawing 9, when traffic inclines in 4-11 to 4-21, and 4-12 to 4-22 etc., the link of 5-11 and 5-22 carries out congestion, and it is known for the example that the throughput of a switch will deteriorate remarkably.
0010 This invention was carried out to such a background and is ****. The purpose is to provide the ATM switch which can cancel link connection and can cancel the bias of traffic. An object of this invention is to provide an ATM switch with little hardware quantity, even if large-scale. An object of this invention is to provide the ATM switch which can respond to the change in an input-and-output number of circuit flexibly.
0011
Means for Solving the Problem This invention connecting between basic switches by a

wavelength multiplexing link, and connecting by barrel shifter which distributes a signal of each multiplex link for every wavelength, and by inputting into line input again a cell outputted from an output line, Re-routing is performed, and when a cell outputted to a cell or an output line which arrived at making a congestion part avoid at the time of a congestion occurrence and line input is a cell by which the multiple address is carried out to two or more addresses, it is characterized **main** by copying this cell and distributing to two or more addresses.

0012A point which is reducing the number of links by wavelength multiplexing with a Prior art, a point which has chosen a basic switch of an output side for every wavelength, When are seen with one output side basic switch and a point connected by the link by which wavelength differs for every input-side basic switch, and a bias of traffic occur, a point that re-routing can be used differs from a point of performing copy distribution about multiple address cells.

0013 Namely, an ATM switch whose this invention is characterized by that an ATM switch provided with two or more output switch blocks comprises the following.

A basic switch which distributes a cell which accommodates two or more line input and comes from this line input to N tracks, respectively.

An electric phototransducer which changes into a lightwave signal of wavelength (lambda$_0$ - lambda$_{N-1}$) of N pieces different, respectively N cells outputted from this basic switch.

A branching filter which separates spectrally an input switch block provided with a multiplexing machine which multiplexs a lightwave signal of this wavelength of N pieces to one wavelength-multiplexing-light signal into a lightwave signal of wavelength (lambda$_0$ - lambda$_{N-1}$) of N pieces which is different, respectively in two or more preparations and said one wavelength-multiplexing-light signal.

A photoelectricity converter which changes a lightwave signal of this wavelength (lambda$_0$ - lambda$_{N-1}$) of N pieces into N cells, respectively, and a basic switch which distributes this N cell to two or more output lines, respectively.

0014 Here a place by which it is characterized **of this invention** An output link of two or more of said multiplexing machines, It has barrel shifter which distributes a lightwave signal of wavelength lambda$_p$ (0 <=p<=N-1) of the n-th input (0 <=n<=N-1) to an output of eye watch (mod N (n+p)) between input links of two or more of said branching filters, It is in a place provided with a means to input into said input switch block by return a cell outputted from said output switch blocks.

0015 Thereby, a cell which comes from two or more line input can be distributed to an output line which becomes settled for every wavelength. At this time, an internal link of an ATM switch can be easily constituted by using barrel shifter.

0016 As for said means which carries out a clinch input, it is desirable to include a means to change a header of a cell outputted from said output switch blocks for re-routing.

0017 Thus, by turning up and carrying out routing of the outputted cell to the line input side again once, a part which congestion generated can be bypassed and routing can be performed.

0018 Although said input switch block and said output switch blocks can also be made into same number preparation ******, since the number can be arbitrarily set up by using barrel shifter, an ATM switch with high flexibility of a design is realizable.

0019 It can also have composition provided with a means to copy and distribute a cell outputted from a cell inputted into said input switch block, or said output switch blocks to desired two or more addresses.

0020

Embodiment of the Invention

0021

ExampleThe composition of this invention example is explained with reference to drawing 1 - drawing 4. Drawing 1 is an entire configuration figure of this invention example.

0022 This invention is an ATM switch and The line input 6-311 to 6-318, --, The basic switch 4-11 to 4-18 which accommodates 6-381 to 6-388, and distributes this line input 6-311 to 6-318, --, the cell that comes from 6-381 to 6-388 to eight tracks, respectively, Electric phototransducer EO$_{0A}$-EO$_{7A}$ which changes into the lightwave signal of wavelength of eight pieces different, respectively eight cells outputted from this basic switch 4-11 to 4-18, --, EO$_{0H}$ - EO$_{7H}$, It has the input switch blocks IN1-IN8 provided with the multiplexing machine 7-1 to 7-8 which multiplexs the lightwave signal of this wavelength of eight pieces to one wavelength-

multiplexing-light signal, The branching filter 8-1 to 8-8 which separates said one wavelength-multiplexing-light signal spectrally into the lightwave signal of wavelength of eight pieces different, respectively, Photoelectricity converter OE_{0A}-OE_{1H} which changes the lightwave signal of this wavelength of eight pieces into eight cells, respectively, --, OE_{7A} - OE_{0H}, It is the ATM switch provided with the output switch blocks OUT1-OUT8 provided with two or more output lines 6-411 to 6-418, --, the basic switch 4-21 to 4-28 distributed to 6-481 to 6-488, respectively for this eight cell.

0023 Here the place by which it is characterized **of this invention** The output link 5-11 to 5-18 of the multiplexing machine 7-1 to 7-8, It has the barrel shifter 6 which distributes the lightwave signal of wavelength lambda$_p$ (0<=p<=7) of the n-th input (0<=n<=7) to the output of eye watch (mod(n+p)8) between the input links 5-21 to 5-28 of the branching filter 8-1 to 8-8, It is in the place provided with the circuit corresponding points LU18-LU88 as a means to input into the input switch blocks IN1-IN8 by return the cell outputted from the output switch blocks OUT1-OUT8.

0024 The circuit corresponding points LU18-LU88 contain the header conversion part 1003 as a means which changes the header of the cell outputted from the output switch blocks OUT1-OUT8 for re-routing.

0025 To the circuit corresponding points LU18-LU88. It has the preferential control circuit 1012 and the header conversion part 1002 as a means which copy and distribute the cell outputted from the cell or the output switch blocks OUT1-OUT8 which were inputted into the input switch blocks IN1-IN8 to desired two or more addresses.

0026 Next, operation of this invention example is explained. Drawing 2 is a block lineblock diagram of an input switch block. Drawing 3 is a block lineblock diagram of output switch blocks. The basic switch 4-11 of 8x8 distributed to eight tracks, respectively as input switch block IN1 is shown in drawing 2, Electric phototransducer EO_{0A} which changes into eight lightwave signals of wavelength lambda$_{0A}$ - lambda$_{7A}$ different, respectively eight cells outputted from this basic switch 4-11 - EO_{7A}, It has the multiplexing machine 7-1 which multiplexs these eight lightwave signals of wavelength lambda$_{0A}$ - lambda$_{7A}$ to one wavelength-multiplexing-light signal, and is constituted, and a wavelength-multiplexing-light signal is outputted to the wavelength multiplexing link 5-11. The input switch blocks IN2-IN8 are also the same composition as IN1.

0027 As shown in drawing 3, output-switch-blocks OUT1, The branching filter 8-1 which separates spectrally into the lightwave signal of eight wavelength lambda$_{0A}$ different, respectively, lambda$_{7B}$ - lambda$_{1H}$ the wavelength-multiplexing-light signal inputted from the wavelength multiplexing link 5-21 of one, It has photoelectricity converter OE_{0A} which changes these eight lightwave signals of wavelength lambda$_{0A}$ - lambda$_{1H}$ into eight cells, respectively - OE_{1H}, and the 8x8 basic switch 4-21 which distributes this eight cell to the switch print-out line 6-211 to 6-228, and is constituted.
The output switch blocks OUT2-OUT8 are also the same composition as output-switch-blocks OUT1.

0028 The output (switch output line 6-211 to 6-288) of the output switch blocks OUT1-OUT8 is outputted to the output line 6-411 to 6-488 via the circuit corresponding points LU18-LU88.

0029 Although drawing 4 is a block lineblock diagram of circuit corresponding point LU11, It is connected to the switch input circuit 6-111 via the header conversion circuit where 6-311 rewrites line input and 1001 rewrites routing information, and the preferential control circuit 1011 constituted by two or more cue 1021 and 1031 and arbiters 1041.

0030 The information inputted from the switch output line 6-211 is outputted to the output line 6-411 via the preferential control circuit 1013, and also by the header conversion circuit 1003, can rewrite a routing header and can also input it into the switch input circuit 6-111 again.

0031 The preferential control circuits 1011 and 1013 are provided with the cue 1021 and 1031, and 1023 and 1033, respectively, and the arbiters 1041 and 1043, A cell with a higher priority is preferentially read among the cells stored in these cue 1021 and 1031 and the head position of 1023 and 1033. The priority information of the cell is written in the header of the cell.
The arbiters 1041 and 1043 determine the cell read preferentially by extracting this priority information.

0032 In drawing 4, the preferential control circuit 1012 and the header conversion machine 1002 are options, The cell inputted from the line input 6-311 and the switch output line 6-211 can be made equivalent to numbers arbitrary in both directions of the switch input circuit 6-111 and the output line 6-411 of virtual channels, and information can be distributed and outputted (bidirectional distribution connection).

0033 Thus, the ATM switch which corresponded to the demand fluctuation about distribution connection flexibly and in which one-pair many connection is possible can be provided by arranging a bidirectional distribution connecting means at the circuit corresponding points LU18-LU88 (refer to JP,9-83519,A).

0034 The first feature of this invention is in the place provided with the barrel shifter 6 which distributes the lightwave signal of wavelength lambda_p of the n-th input to the output of eye watch $(\text{mod}(n+p)8)$ between the wavelength multiplexing link 5-11 to 5-18 of eight, and the wavelength multiplexing link 5-21 to 5-28 of eight so that drawing 1 may show. However, it is $0 <= n$ and $p <= 7$.

0035 By return the second feature to the circuit corresponding points LU18-LU88 of a basic switch and the ATM switch located between each input-and-output circuit The header conversion part 1003 as a connecting means, Or it is having arranged the preferential control circuit 1012 and the header conversion part 1002 as a distribution connecting means to both directions.

0036 Therefore, although traffic is transmitted to a certain output line 6-411 to 6-488 from a certain line input 6-311 to 6-388, two or more routes exist, and it has the composition that it can respond to the bias of traffic.

0037 The barrel shifter 6 is explained with reference to drawing 6. Drawing 6 is a figure showing the distribution state of the lightwave signal of the barrel shifter 6. It explains that there are two line input #0 and #1, four output line #0 - #3 as shown in drawing 6.

0038 The lightwave signal of wavelength lambda_0 - lambda_3 is transmitted to line input #0 and #1. The lightwave signal of wavelength lambda_0 of line input #0, lambda_1, lambda_2, and lambda_3 is set to the output lines in output line #0, #1, #2, and #3, respectively. The lightwave signal of wavelength lambda_0 of line input #1, lambda_1, lambda_2, and lambda_3 is set to the output lines in output line #0, #1, #2, and #3, respectively.

0039 Therefore, the wavelength which makes output line #1 output lines, for example among the lightwave signals transmitted in line input #0 is lambda_1. The wavelength which makes output line #1 output lines among the lightwave signals transmitted in line input #1 is lambda_0. Therefore, what is necessary is just to input the cell into electric phototransducer EO_{0A} changed into the lightwave signal of wavelength lambda_{0A} in the basic switch 4-11 shown in drawing 2, when there is a cell which makes output-switch-blocks OUT1 the output lines. The cell inputted into electric phototransducer EO_{0A} serves as a lightwave signal of wavelength lambda_{0A}, is inputted into the barrel shifter 6 via the link 5-11, is outputted to the link 5-21, and reaches output-switch-blocks OUT1. The relation of the wavelength of the input/output port of barrel shifter in case the number of input and output is 8 is as being shown in Table 1.

0040
Table 1

For drawings please refer to the original document.

Barrel shifter is known art, and since it is directly unrelated to this invention, the detailed explanation is omitted (reference: "optical multiplexer/demultiplexer using an array waveguide diffraction grating" besides Institute of Electronics, Information and Communication Engineers, study group report, and PST-91-48, PP41-46, and Hiroshi Takahashi).

0041 Next, operation of this invention example is explained. The cell inputted into the input switch blocks IN1-IN8 via the circuit corresponding points LU11-LU88 is switched by the 8x8 basic switch 4-11 to 4-18 of an input side. According to the output lines switched in the basic switch 4-11 to 4-18, the output switch blocks OUT1-OUT8 used as the destination are determined.

0042 For example, what is necessary is just to input the cell into electric phototransducer EO_{0A} changed into the lightwave signal of wavelength lambda_{0A}, when there is a cell which makes

output-switch-blocks OUT1 the output lines in the cell inputted into input switch block IN1.

0043 The cell inputted into electric phototransducer EO_{0A} serves as a lightwave signal of wavelength $lambda_{0A}$, is inputted into the barrel shifter 6 via the link 5-11, is outputted to the link 5-21, and reaches output-switch-blocks OUT1.

0044 About input switch block IN1, the operation is explained further. The cell outputted from the basic switch 4-11 is changed into the lightwave signal of wavelength $lambda_{0A}$ - $lambda_{7A}$ by electric phototransducer EO_{0A} - EO_{7A}, respectively. It is multiplexed as one serial signal with the multiplexing machine 7-1, and this lightwave signal is outputted to the link 5-11.

0045 In the barrel shifter 6, selection distribution is carried out in the output link 5-21 to 5-28 at every wavelength $lambda_{0A}$ - $lambda_{7A}$. On the other hand, if its attention is paid to one output link, for example, 5-21, from each input switch blocks IN1-IN8, wavelength multiplexing of the lightwave signal will be carried out, and it will be transmitted.

0046 In the branching filter 8-1, the lightwave signal by which wavelength multiplexing was carried out from each input switch blocks IN1-IN8 is separated spectrally, and it changes into the cell of an electrical signal by photoelectricity converter OE_{0A} - OE_{1H}, and outputs to the desired switch print-out line 6-211 to 6-218 with the basic switch 4-21.

0047 For example, if it is connection with output line #4 **of the basic switch 4-11** of the basic switch 4-21 from line input #2, $lambda_{0A}$ of the upper row is chosen with the basic switch 4-11, and it is transmitted to output-switch-blocks OUT1 by the barrel shifter 6, is separated spectrally into the basic switch 4-21 with the branching filter 8-1, and is connected to output line #4 by the basic switch 4-21.

0048 Thus, the cell which comes from two or more line input can be distributed to the output line which becomes settled for every wavelength. At this time, the internal link of an ATM switch can be easily constituted by using the barrel shifter 6.

0049 Operation when the bias of traffic arises is explained using drawing 5. Drawing 5 is a figure showing the example which the bias of traffic produced. The example when the traffic of input switch block IN1 is concentrating on output-switch-blocks OUT1 is shown. By choosing $lambda_0$ for transmitting a cell to OUT1 from IN1, transmitting automatically by barrel shifter is possible. However, if an input port is made into 1 Gb/s internal link and the throughput which it is got blocked and can be transmitted by $lambda_0$ is made into 1 Gb/s, the traffic of 1 or more Gb/s may incline toward OUT1 from IN1. In this case, only 1 Gb/s can be transmitted and the remaining information will be treated as call loss. In the example of drawing 5, it has transmitted to OUT1 by making $lambda_1$ choose as a part of traffic transmitted to OUT1, transmitting to the output switch blocks of OUT8, making it feed back to IN8 and choosing an input from IN8 by the clinch connect function of LU88, further.

0050 If this method is extended, 1+56 kinds of roots will be secured to OUT1 from IN1. Thereby, when congestion occurs in an ATM switch, routing which avoided the congestion occurrence part can be performed.

0051

Effect of the Invention As explained above, according to this invention, complicated link connection is cancelable. By this, even if large-scale, there can be little hardware quantity, the ATM switch which can cancel the bias of traffic can be realized, and it can respond to the change in an input-and-output number of circuit flexibly.

Field of the Invention This invention is used for ATM (Asynchronous Transfer Mode: Asynchronous Transfer Mode) communication. This invention relates to the art which carries out wire saving of the internal link of an ATM switch. This invention relates to the art of applying optical devices since an ATM switch is constituted.

Description of the Prior ArtA conventional example is explained with reference to drawing 7 and drawing 8. Drawing 7 is a figure showing the composition of the 4x4 basic switch in the conventional ATM switch. Drawing 7 explains an input buffer type basic switch among the composition of a basic switch (reference: a point illustration type standard ATM textbook, the

ASCII publication office (ISBN4-7561-0250-6)).

0003 Operation of the conventional basic switch is explained with reference to drawing 7. In drawing 7, the numerals 1 are crosspoints which transmit an ATM cell to a desired output. The numerals 2-1 to 2-4 are input buffers which accumulate the cell which came temporarily. The numerals 2 are controllers which perform contention control of a cell. The numerals 3-1 to 3-4 are output highways.

0004 It communicates between each input buffer 2-1 to 2-4, and it obtains permission of sending out by the controller 2 so that it may not transmit to the same output highway 3-1 to 3-4 from the input buffer 2-1 to 2-4. The crosspoint 1 is provided with address filter AF, and transmits a cell to the applicable output highway 3-1 to 3-4 based on the information in a header.

0005 Drawing 8 is a figure showing the composition of the conventional ATM switch. Using the basic switch of 4x4 shown by drawing 7 two or more, as shown in drawing 8, an ATM switch is constituted. In drawing 8, it is a link with which the numerals 4-11-24 connect a basic switch, and the numerals 5-11-13 connect between basic switches. Thus, the ATM switch of 16x16 can be constituted using the basic switch of 4x4.

Effect of the Invention As explained above, according to this invention, complicated link connection is cancelable. By this, even if large-scale, there can be little hardware quantity, the ATM switch which can cancel the bias of traffic can be realized, and it can respond to the change in an input-and-output number of circuit flexibly.

ExampleThe composition of this invention example is explained with reference to drawing 1 - drawing 4. Drawing 1 is an entire configuration figure of this invention example.

0022 This invention is an ATM switch and The line input 6-311 to 6-318, --, The basic switch 4-11 to 4-18 which accommodates 6-381 to 6-388, and distributes this line input 6-311 to 6-318, --, the cell that comes from 6-381 to 6-388 to eight tracks, respectively, Electric phototransducer EO_{0A}-EO_{7A} which changes into the lightwave signal of wavelength of eight pieces different, respectively eight cells outputted from this basic switch 4-11 to 4-18, --, EO_{0H} - EO_{7H}, It has the input switch blocks IN1-IN8 provided with the multiplexing machine 7-1 to 7-8 which multiplexs the lightwave signal of this wavelength of eight pieces to one wavelength-multiplexing-light signal, The branching filter 8-1 to 8-8 which separates said one wavelength-multiplexing-light signal spectrally into the lightwave signal of wavelength of eight pieces different, respectively, Photoelectricity converter OE_{0A}-OE_{1H} which changes the lightwave signal of this wavelength of eight pieces into eight cells, respectively, --, OE_{7A} - OE_{0H}, It is the ATM switch provided with the output switch blocks OUT1-OUT8 provided with two or more output lines 6-411 to 6-418, --, the basic switch 4-21 to 4-28 distributed to 6-481 to 6-488, respectively for this eight cell.

0023 Here the place by which it is characterized **of this invention** The output link 5-11 to 5-18 of the multiplexing machine 7-1 to 7-8, It has the barrel shifter 6 which distributes the lightwave signal of wavelength lambda$_p$ (0<=p<=7) of the n-th input (0<=n<=7) to the output of eye watch (mod(n+p)8) between the input links 5-21 to 5-28 of the branching filter 8-1 to 8-8, It is in the place provided with the circuit corresponding points LU18-LU88 as a means to input into the input switch blocks IN1-IN8 by return the cell outputted from the output switch blocks OUT1-OUT8.

0024 The circuit corresponding points LU18-LU88 contain the header conversion part 1003 as a means which changes the header of the cell outputted from the output switch blocks OUT1-OUT8 for re-routing.

0025 To the circuit corresponding points LU18-LU88. It has the preferential control circuit 1012 and the header conversion part 1002 as a means which copy and distribute the cell outputted from the cell or the output switch blocks OUT1-OUT8 which were inputted into the input switch blocks IN1-IN8 to desired two or more addresses.

0026 Next, operation of this invention example is explained. Drawing 2 is a block lineblock diagram of an input switch block. Drawing 3 is a block lineblock diagram of output switch

blocks. The basic switch 4-11 of 8x8 distributed to eight tracks, respectively as input switch block IN1 is shown in drawing 2, Electric phototransducer EO_{0A} which changes into eight lightwave signals of wavelength $lambda_{0A}$ - $lambda_{7A}$ different, respectively eight cells outputted from this basic switch 4-11 - EO_{7A}, It has the multiplexing machine 7-1 which multiplexs these eight lightwave signals of wavelength $lambda_{0A}$ - $lambda_{7A}$ to one wavelength-multiplexing-light signal, and is constituted, and a wavelength-multiplexing-light signal is outputted to the wavelength multiplexing link 5-11. The input switch blocks IN2-IN8 are also the same composition as IN1.

0027 As shown in drawing 3, output-switch-blocks OUT1, The branching filter 8-1 which separates spectrally into the lightwave signal of eight wavelength $lambda_{0A}$ different, respectively, $lambda_{7B}$ - $lambda_{1H}$ the wavelength-multiplexing-light signal inputted from the wavelength multiplexing link 5-21 of one, It has photoelectricity converter OE_{0A} which changes these eight lightwave signals of wavelength $lambda_{0A}$ - $lambda_{1H}$ into eight cells, respectively - OE_{1H}, and the 8x8 basic switch 4-21 which distributes this eight cell to the switch print-out line 6-211 to 6-228, and is constituted.

The output switch blocks OUT2-OUT8 are also the same composition as output-switch-blocks OUT1.

0028 The output (switch output line 6-211 to 6-288) of the output switch blocks OUT1-OUT8 is outputted to the output line 6-411 to 6-488 via the circuit corresponding points LU18-LU88.

0029 Although drawing 4 is a block lineblock diagram of circuit corresponding point LU11, It is connected to the switch input circuit 6-111 via the header conversion circuit where 6-311 rewrites line input and 1001 rewrites routing information, and the preferential control circuit 1011 constituted by two or more cue 1021 and 1031 and arbiters 1041.

0030 The information inputted from the switch output line 6-211 is outputted to the output line 6-411 via the preferential control circuit 1013, and also by the header conversion circuit 1003, can rewrite a routing header and can also input it into the switch input circuit 6-111 again.

0031 The preferential control circuits 1011 and 1013 are provided with the cue 1021 and 1031, and 1023 and 1033, respectively, and the arbiters 1041 and 1043, A cell with a higher priority is preferentially read among the cells stored in these cue 1021 and 1031 and the head position of 1023 and 1033. The priority information of the cell is written in the header of the cell. The arbiters 1041 and 1043 determine the cell read preferentially by extracting this priority information.

0032 In drawing 4, the preferential control circuit 1012 and the header conversion machine 1002 are options, The cell inputted from the line input 6-311 and the switch output line 6-211 can be made equivalent to numbers arbitrary in both directions of the switch input circuit 6-111 and the output line 6-411 of virtual channels, and information can be distributed and outputted (bidirectional distribution connection).

0033 Thus, the ATM switch which corresponded to the demand fluctuation about distribution connection flexibly and in which one-pair many connection is possible can be provided by arranging a bidirectional distribution connecting means at the circuit corresponding points LU18-LU88 (refer to JP,9-83519,A).

0034 The first feature of this invention is in the place provided with the barrel shifter 6 which distributes the lightwave signal of wavelength $lambda_p$ of the n-th input to the output of eye watch (mod(n+p)8) between the wavelength multiplexing link 5-11 to 5-18 of eight, and the wavelength multiplexing link 5-21 to 5-28 of eight so that drawing 1 may show. However, it is $0<=n$ and $p<=7$.

0035 By return the second feature to the circuit corresponding points LU18-LU88 of a basic switch and the ATM switch located between each input-and-output circuit The header conversion part 1003 as a connecting means, Or it is having arranged the preferential control circuit 1012 and the header conversion part 1002 as a distribution connecting means to both directions.

0036 Therefore, although traffic is transmitted to a certain output line 6-411 to 6-488 from a certain line input 6-311 to 6-388, two or more routes exist, and it has the composition that it can respond to the bias of traffic.

0037 The barrel shifter 6 is explained with reference to drawing 6. Drawing 6 is a figure

showing the distribution state of the lightwave signal of the barrel shifter 6. It explains that there are two line input #0 and #1, four output line #0 - #3 as shown in drawing 6.

0038 The lightwave signal of wavelength $lambda_0$ - $lambda_3$ is transmitted to line input #0 and #1. The lightwave signal of wavelength $lambda_0$ of line input #0, $lambda_1$, $lambda_2$, and $lambda_3$ is set to the output lines in output line #0, #1, #2, and #3, respectively. The lightwave signal of wavelength $lambda_0$ of line input #1, $lambda_1$, $lambda_2$, and $lambda_3$ is set to the output lines in output line #0, #1, #2, and #3, respectively.

0039 Therefore, the wavelength which makes output line #1 output lines, for example among the lightwave signals transmitted in line input #0 is $lambda_1$. The wavelength which makes output line #1 output lines among the lightwave signals transmitted in line input #1 is $lambda_0$. Therefore, what is necessary is just to input the cell into electric phototransducer EO_{0A} changed into the lightwave signal of wavelength $lambda_{0A}$ in the basic switch 4-11 shown in drawing 2, when there is a cell which makes output-switch-blocks OUT1 the output lines. The cell inputted into electric phototransducer EO_{0A} serves as a lightwave signal of wavelength $lambda_{0A}$, is inputted into the barrel shifter 6 via the link 5-11, is outputted to the link 5-21, and reaches output-switch-blocks OUT1. The relation of the wavelength of the input/output port of barrel shifter in case the number of input and output is 8 is as being shown in Table 1.

0040
Table 1

For drawings please refer to the original document.

Barrel shifter is known art, and since it is directly unrelated to this invention, the detailed explanation is omitted (reference: "optical multiplexer/demultiplexer using an array waveguide diffraction grating" besides Institute of Electronics, Information and Communication Engineers, study group report, and PST-91-48, PP41-46, and Hiroshi Takahashi).

0041 Next, operation of this invention example is explained. The cell inputted into the input switch blocks IN1-IN8 via the circuit corresponding points LU11-LU88 is switched by the 8x8 basic switch 4-11 to 4-18 of an input side. According to the output lines switched in the basic switch 4-11 to 4-18, the output switch blocks OUT1-OUT8 used as the destination are determined.

0042 For example, what is necessary is just to input the cell into electric phototransducer EO_{0A} changed into the lightwave signal of wavelength $lambda_{0A}$, when there is a cell which makes output-switch-blocks OUT1 the output lines in the cell inputted into input switch block IN1.

0043 The cell inputted into electric phototransducer EO_{0A} serves as a lightwave signal of wavelength $lambda_{0A}$, is inputted into the barrel shifter 6 via the link 5-11, is outputted to the link 5-21, and reaches output-switch-blocks OUT1.

0044 About input switch block IN1, the operation is explained further. The cell outputted from the basic switch 4-11 is changed into the lightwave signal of wavelength $lambda_{0A}$ - $lambda_{7A}$ by electric phototransducer EO_{0A} - EO_{7A}, respectively. It is multiplexed as one serial signal with the multiplexing machine 7-1, and this lightwave signal is outputted to the link 5-11.

0045 In the barrel shifter 6, selection distribution is carried out in the output link 5-21 to 5-28 at every wavelength $lambda_{0A}$ - $lambda_{7A}$. On the other hand, if its attention is paid to one output link, for example, 5-21, from each input switch blocks IN1-IN8, wavelength multiplexing of the lightwave signal will be carried out, and it will be transmitted.

0046 In the branching filter 8-1, the lightwave signal by which wavelength multiplexing was carried out from each input switch blocks IN1-IN8 is separated spectrally, and it changes into the cell of an electrical signal by photoelectricity converter OE_{0A} - OE_{1H}, and outputs to the desired switch print-out line 6-211 to 6-218 with the basic switch 4-21.

0047 For example, if it is connection with output line #4 **of the basic switch 4-11** of the basic switch 4-21 from line input #2, $lambda_{0A}$ of the upper row is chosen with the basic switch 4-11, and it is transmitted to output-switch-blocks OUT1 by the barrel shifter 6, is separated spectrally into the basic switch 4-21 with the branching filter 8-1, and is connected to output line #4 by the basic switch 4-21.

0048 Thus, the cell which comes from two or more line input can be distributed to the output line which becomes settled for every wavelength. At this time, the internal link of an ATM switch can be easily constituted by using the barrel shifter 6.

0049 Operation when the bias of traffic arises is explained using drawing 5. Drawing 5 is a figure showing the example which the bias of traffic produced. The example when the traffic of input switch block IN1 is concentrating on output-switch-blocks OUT1 is shown. By choosing $lambda_0$ for transmitting a cell to OUT1 from IN1, transmitting automatically by barrel shifter is possible. However, if an input port is made into 1 Gb/s internal link and the throughput which it is got blocked and can be transmitted by $lambda_0$ is made into 1 Gb/s, the traffic of 1 or more Gb/s may incline toward OUT1 from IN1. In this case, only 1 Gb/s can be transmitted and the remaining information will be treated as call loss. In the example of drawing 5, it has transmitted to OUT1 by making $lambda_1$ choose as a part of traffic transmitted to OUT1, transmitting to the output switch blocks of OUT8, making it feed back to IN8 and choosing an input from IN8 by the clinch connect function of LU88, further.

0050 If this method is extended, 1+56 kinds of roots will be secured to OUT1 from IN1. Thereby, when congestion occurs in an ATM switch, routing which avoided the congestion occurrence part can be performed.

Problem(s) to be Solved by the Invention In constituting an ATM switch as shown in drawing 8, using the basic switch shown in drawing 7 two or more, 16 4x4 is needed, and the wiring itself becomes entangled mutually, and a link becomes complicated.

0007 Since the number of basic switches will be tens of pieces or hundreds of pieces, a large-scale actual ATM switch will become huge **the number of links** .

0008 Although constituted using an optical fiber, a link requires time and effort for the process of connecting wiring, and since the check process for avoiding faulty wiring etc. is further added to this, it causes the rise of apparatus cost, and long time-ization of a construction period. Whenever it fluctuates a basic switch, it is necessary to change wiring again to all the basic switches, and the flexibility of the change in a basic switch is low.

0009 Although drawing 9 is a figure showing the congestion state of traffic, as shown in drawing 9, when traffic inclines in 4-11 to 4-21, and 4-12 to 4-22 etc., the link of 5-11 and 5-22 carries out congestion, and it is known for the example that the throughput of a switch will deteriorate remarkably.

0010 This invention was carried out to such a background and is ****. The purpose is to provide the ATM switch which can cancel link connection and can cancel the bias of traffic. An object of this invention is to provide an ATM switch with little hardware quantity, even if large-scale. An object of this invention is to provide the ATM switch which can respond to the change in an input-and-output number of circuit flexibly.

Means for Solving the Problem This invention connecting between basic switches by a wavelength multiplexing link, and connecting by barrel shifter which distributes a signal of each multiplex link for every wavelength, and by inputting into line input again a cell outputted from an output line, Re-routing is performed, and when a cell outputted to a cell or an output line which arrived at making a congestion part avoid at the time of a congestion occurrence and line input is a cell by which the multiple address is carried out to two or more addresses, it is characterized **main** by copying this cell and distributing to two or more addresses.

0012A point which is reducing the number of links by wavelength multiplexing with a Prior art, a point which has chosen a basic switch of an output side for every wavelength, When are seen with one output side basic switch and a point connected by the link by which wavelength differs for every input-side basic switch, and a bias of traffic occur, a point that re-routing can be used differs from a point of performing copy distribution about multiple address cells.

0013 Namely, an ATM switch whose this invention is characterized by that an ATM switch provided with two or more output switch blocks comprises the following.
A basic switch which distributes a cell which accommodates two or more line input and comes from this line input to N tracks, respectively.
An electric phototransducer which changes into a lightwave signal of wavelength ($lambda_0$ -

lambda$_{N-1}$) of N pieces different, respectively N cells outputted from this basic switch.

A branching filter which separates spectrally an input switch block provided with a multiplexing machine which multiplexs a lightwave signal of this wavelength of N pieces to one wavelength-multiplexing-light signal into a lightwave signal of wavelength (lambda$_0$ - lambda$_{N-1}$) of N pieces which is different, respectively in two or more preparations and said one wavelength-multiplexing-light signal.

A photoelectricity converter which changes a lightwave signal of this wavelength (lambda$_0$ - lambda$_{N-1}$) of N pieces into N cells, respectively, and a basic switch which distributes this N cell to two or more output lines, respectively.

0014 Here a place by which it is characterized **of this invention** An output link of two or more of said multiplexing machines, It has barrel shifter which distributes a lightwave signal of wavelength lambda$_p$ (0 <=p<=N-1) of the n-th input (0 <=n<=N-1) to an output of eye watch (mod N (n+p)) between input links of two or more of said branching filters, It is in a place provided with a means to input into said input switch block by return a cell outputted from said output switch blocks.

0015 Thereby, a cell which comes from two or more line input can be distributed to an output line which becomes settled for every wavelength. At this time, an internal link of an ATM switch can be easily constituted by using barrel shifter.

0016 As for said means which carries out a clinch input, it is desirable to include a means to change a header of a cell outputted from said output switch blocks for re-routing.

0017 Thus, by turning up and carrying out routing of the outputted cell to the line input side again once, a part which congestion generated can be bypassed and routing can be performed.

0018 Although said input switch block and said output switch blocks can also be made into same number preparation ******, since the number can be arbitrarily set up by using barrel shifter, an ATM switch with high flexibility of a design is realizable.

0019 It can also have composition provided with a means to copy and distribute a cell outputted from a cell inputted into said input switch block, or said output switch blocks to desired two or more addresses.

0020

Embodiment of the Invention

Brief Description of the Drawings
Drawing 1 The entire configuration figure of this invention example.
Drawing 2 The block lineblock diagram of an input switch block.
Drawing 3 The block lineblock diagram of output switch blocks.
Drawing 4 The block lineblock diagram of a circuit corresponding point.
Drawing 5 The figure showing the example which the bias of traffic produced.
Drawing 6 The figure showing the distribution state of the lightwave signal of barrel shifter.
Drawing 7 The figure showing the composition of the 4x4 basic switch in the conventional ATM switch.
Drawing 8 The figure showing the composition of the conventional ATM switch.
Drawing 9 The figure showing the congestion state of traffic.
Description of Notations
1 Crosspoint
2 Controller
2-1 - 2-4 input buffer
3-1 - 3-4 output highway
4-11 to 4-18, and 4-21 to 4-28 Basic switch
5-11 to 5-18, and 5-21 to 5-28 Link
6 Barrel shifter
6-111 - a 6-181 switch-input circuit
6-211-6-281 Switch output line
6-311-6-388 Line input
6-411-6-488 Output line
7-1-7-8 Multiplexing machine

8-1-8-8 Branching filter
1001 - 1003 header-conversion machine
1011-1013 Preferential control circuit
1021-1023, 1031-1033 Cue
1041-1043 Arbiter
AF Address filter
EO_{0A}-EO_{7A}, --, EO_{0H} - EO_{7H} photoelectricity converter
IN1-IN8 Input switch block
LU11-LU88 Circuit corresponding point
OE_{0A}-OE_{1H}, --, OE_{7A} - an OE_{0H} electrical-and-electric-equipment phototransducer
OUT1 - OUT8 output switch blocks

Drawing 1

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

Drawing 6

For drawings please refer to the original document.

Drawing 7

For drawings please refer to the original document.

Drawing 8

For drawings please refer to the original document.

Drawing 9

For drawings please refer to the original document.

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